REMARKS

The applicants express their appreciation to Examiner Craig H. Curtis for the courtesy of an interview which was granted to the applicants' representative, Sanford T. Colb (Reg. No. 26,856), and was held at the Examiner's office at the USPTO on January 6, 2004, the substance of the interview being set forth in the Interview Summary, Paper No. 11 given to the applicants' representative. The applicants also wish to express their appreciation to Primary Examiner Audrey Chang for the courtesy of a second interview granted to the applicant's representative, held together with Examiner Craig H. Curtis at the USPTO on January 7, 2004, the substance of the second interview being set forth in the Interview Summary, currently designated Paper No. 01072004, which too was given to the applicants' representative. At the first interview, an amended claim 17 was proposed which appears to distinguish over the art of record and to overcome 35 USC 112 issues, and at the second interview, the language of this claim was further clarified. The Examiner will perform an additional search following this submission of the formal amendment.

The applicants have carefully studied the outstanding Office Action. The applicants believe the present amendment to be fully responsive to all points of rejection raised by the Examiner, and to place the application in condition for allowance. Favorable reconsideration and allowance of the application are respectfully requested.

Claims

The applicants have cancelled claims 1-16 without prejudice.

The applicants have added new claims 17-24.

New independent claim 17 replaces cancelled claim 9, and essentially contains the elements of claim 9 and claim 16, with the additional recitation that each point of optical breakdown damage produced by the focused pulsed laser beam is a light scattering center. Support for this additional recitation is found in the specification on page 5, paragraph 4,

lines 2-4, on page 6, lines 2-4, and on page 7, lines 5-7.

Additionally, the order of the elements of claim 17 has been amended from that of cancelled claim 9 to ensure correct antecedent basis for each mentioned item in the claim. Claims 10 to 15 have been represented as new claims 19-24 but are amended to be dependent on new claim 17, instead of their original dependence on cancelled claim 9.

Claim 18 recites a further limitation of the pulsed laser beam, support for which is found in the specification on page 7, line 9.

Claim rejections - 35 USC § 112

Claims 9-16 are rejected under 35 U.S.C. 112, first paragraph, as being "based on a disclosure which is not enabling; more specifically, said method critical or essential to the practice of the invention, but not included in the claims, is not enabled by the disclosure. .... Initially, it is noted that no logical relationship has been established in these claims between the developing & computing steps (both of which are purely mathematical/computational in nature) and said focusing step (which is physically realizable in nature)". The Examiner further asks "how light can be scattered from a three-dimensional set of points that is, after all, merely a mathematical construct (as opposed to, for the sake of example, an actual three-dimensional set of points – i.e., a lattice of actual points – such points, of course, being distinguishable from mathematical points, which, by definition, are dimensionless and thus incapable of scattering light)." The Examiner adds that "(t)his issue also arises with regard to the manner in which a laser beam can be focused onto each of said points (*read:* mathematical points) within a solid transparent material."

The applicants respectfully submit that the cancellation without prejudice of claim 9 has rendered the Examiner's rejection of the claims as moot. The applicants however, herewith respond to the Examiner's comments as they relate to the elements of new claim 17, which replaces cancelled claim 9.

New claim 17 recites in its first element, as did cancelled claim 9, the development

of the three-dimensional model of the field emanating from the object which can produce an image of the object. The second element recites a pulsed laser beam, such that each point of optical breakdown damage produced by the beam when focused into the solid transparent material is a light scattering center. The third element of the claim recites the computation of a three-dimensional set of points, such that light scattered from scattering centers located at that set of points reconstructs the desired three-dimensional model. The last element of the claim recites the focusing of the pulsed laser beam onto each of the computed set of points thus creating scattering centers which define the hologram.

The applicants therefore submit that each of the steps recited in claim 17 relate to self consistent concepts, in that delineation has been made between the "developing and computing steps" which relate only to the mathematical/computational three dimensional model and its set of points, and the focusing step, which is operative only on physical scattering centers. The interface or "logical relationship" between the mathematical set of points and the physical scattering centers is generated in the third element of the claim, where it is recited that it is light scattered from scattering centers located at the set of computed three-dimensional points that reconstructs the three-dimensional model field.

The Examiner has further states that the claimed method would not yield a hologram of an object, since "holograms, by their very nature, arise from the interference between at least one object beam and at least one reference beam", and also that "the recordation of holograms is not accomplished in such a localized and sequential manner but, rather in a more gross and generalized fashion."

The applicants respectfully submit that the Examiner's conception of the nature of a hologram, as expressed above, is incomplete. It is indeed possible to generate a hologram by interference of object and reference beams, such as is done when generating analog holograms in a photographic plate. However, within the medium in which it is produced, the hologram is really no more than a collection of scattering or diffracting centers, which modify the intensity and phase of any incident wave, regardless of how produced, and of how viewed or read. Such a collection of scattering or diffracting centers, which can be described as being either analog or digital in nature, can be

produced in any way desired which results in the correct location and scattering effect, both in phase and amplitude, of each center. One such production method is by the familiar method of exposure of a photo-sensitive plate to an object and reference beam suitably aligned, as stated by the Examiner. An alternative method is by laser etching, such as that described in the present application, and if desired, with the digital centers even produced sequentially, contrary to the Examiner's assertion. The difference between prior art analog holograms and the digital Computer Generated Volume Holograms (CGVH's) known from the present invention and even previously, is clearly expounded in the present application at the top of page 6, lines 2-8.

In the light of the above arguments, and in the light of the claim amendments made, the applicants therefore respectfully submit that the Examiner's rejections under 35 U.S.C. 112, first paragraph, are thus overcome, and respectfully request withdrawal of the grounds for rejection of the claims under 35 U.S.C. 112, first paragraph.

Claim rejections - 35 USC § 103

Claims 9-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Troitski et al. (U.S. Patent No. 6,087,617). The Examiner states that "Troitski et al disclose the method as claimed - a method of producing in a solid transparent material, a hologram of an object, comprising *inter alia*, the steps of:

developing a three-dimensional mathematical model of an electro-magnetic field emanating from said object, said field producing an image of said object (see, e.g. col. 4, ll. 38-42);

computing a corresponding three-dimensional set of points; and

focusing a pulsed laser beam (from laser 16) into a solid transparent material, said beam being capable, when focused, of causing optical breakdown damage in said solid transparent material (see col. 3, ll. 65-67 – col. 4, ll. 1-7), EXCEPT FOR explicit disclosure of the following additionally recited limitations:

wherein light scattered from said a corresponding computed three-dimensional set of points, reconstructs said field, ... and wherein said pulsed laser beam focused into said transparent material focuses onto each of said points sequentially."

The Examiner adds that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to have implemented the above-recited additional method steps during the implementation of said system of Troitski et al., for at least the purpose of establishing that a real, not a computed three-dimensional set of points would be needed in order to reconstruct a given field distribution, and that only such a real three dimensional set of points, not a computed set, could in any way be relied upon to focus said pulsed laser beam into said transparent material to accomplish same... in the manner currently set forth in the claims."

The applicants respectfully submit that the cancellation without prejudice of Fig. 9 renders the Examiner's rejection moot. However, the applicants will refer to the elements of the Examiner's rejection in as far as they may be applied to new claim 17.

The applicants respectfully submit that the Examiner is incorrect in his assessment of what is disclosed in Troitski et al. The Examiner has stated that "Troitski et al disclose the method as claimed - a method of producing in a solid transparent material, a hologram of an object, comprising *inter alia*, the steps of:

developing a three-dimensional mathematical model of an electromagnetic field emanating from said object, said field producing an image of said object (see, e.g. col. 4, ll. 38-42); ....."

The applicants respectfully submit that nowhere in Troiski et al., is there mentioned or suggested a method of producing in a solid transparent material, a hologram of an object, comprising the step of developing a three-dimensional mathematical model of an electromagnetic field emanating from an object. Definition of a hologram requires field intensity and phase knowledge, and an electromagnetic field too is defined by the amplitude and phase of the electromagnetic radiation as a function of three-dimensional spatial coordinates and time. To the best of the applicants' understanding, Troiskui et al., is nowhere concerned or involved in the "electromagnetic field" scattered by the etch

points described therein, other than the brightness of light scattering therefrom and its relation to the etch point density. Nowhere is there any mention or suggestion of any form of electromagnetic field description, interaction or development of a mathematical model thereof. Terms such as "phase", "field" or "diffraction", which are characteristic terms which would be expected in any description involving an electromagnetic field model and its interaction with scattering centers, do not even appear in Troitski et al., in relation to the invention itself.

Troiski et al., is concerned only with the well-known methods of laser etched images, made up of **intensity** scattering centers within the medium. Furthermore, the methods of Troiski et al., appear to be limited to finding methods of determining the most economical density of etch points that will represent the desired image brightness at each point of the desired image. Troitski et al., did not relate at all to the way in which the positions of his etch points were calculated, other than to refer to the use of commercial laser digitizing systems, which typically use a CCD camera to generate a plot of the three-dimensional position of every spot on the surface of the object to be imaged (see col. 4, ll. 49-56), and commercially available image processing systems for transferring this digital information into the etching laser control (see col. 4, ll. 56-61).

Therefore the applicants submit that no-one of skill in the art at the time of filing of the present application could have learned from Troitski how to perform the present claimed invention simply by adding to the method described in Troiski et al., the step quoted by the Examiner at the bottom of page 4 of the Office Action, since Troitski in no way mentions, suggests or hints at the basic parameters necessary to perform the claimed method of the present invention, namely a three-dimensional mathematical model of an electromagnetic field emanating from an object in a form which enables it to define a hologram of that object.

From all of the above arguments, the applicants therefore respectfully submit that new claims 17 and 18, and new claims 19-24 (corresponding to amended claims 10-15) are not unpatentable over Troitski et al., and withdrawal of the grounds of rejection of these claims is respectfully requested.

In the light of the above arguments, the applicants respectfully submit that the Examiner's rejections under 35 U.S.C. 103(a) are overcome, that new claim 17 is not unpatentable over Troitski et al., and is deemed allowable, and withdrawal of the grounds of rejection of this claim is respectfully requested. New claims 18-24 are dependent on new claim 17 and recite further patentable matter, and are therefore also deemed allowable.

Conclusions

The applicants therefore respectfully submit that the all of the claims, as amended where applicable, and the added new claims, are believed to define patentable subject matter over the prior art, and are considered to be in condition for allowance. Reconsideration and prompt allowance of this application are therefore respectfully requested.

Respectfully submitted
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